

CLAIMS

1. A surface acoustic wave device comprising a piezoelectric substrate and an IDT that is formed on said piezoelectric substrate and is made from Al or alloy including Al as a main component, an excited wave being an SH wave, wherein

said piezoelectric substrate is a quartz flat plate where a cut angle θ of a rotation Y cut quartz substrate is set in a range of $-64.0^\circ < \theta < -49.3^\circ$ in a counterclockwise direction from a crystal Z-axis, and a propagation direction of a SAW is set to $(90^\circ \pm 5^\circ)$ to a crystal X-axis, and

when a wavelength of the SAW to be excited is represented as λ , an electrode film thickness H/λ standardized by a wavelength of said IDT is set to satisfy $0.04 < H/\lambda < 0.12$.

2. The surface acoustic wave device according to claim 1, wherein a relationship between the cut angle θ and the electrode film thickness H/λ satisfies

$$-1.34082 \times 10^{-4} \times \theta^3 - 2.34969 \times 10^{-2} \times \theta^2 - 1.37506 \times \theta - 26.7895 < H/\lambda < -1.025$$

$$86 \times 10^{-4} \times \theta^3 - 1.73238 \times 10^{-2} \times \theta^2 - 0.977607 \times \theta - 18.3420.$$

3. The surface acoustic wave device according to claim 1, wherein, when an electrode finger width of electrode fingers constituting said IDT/(electrode finger width + space between electrode fingers) is defined as a line metalization ratio mr ,

a relationship between the cut angle θ and a product $H/\lambda \times mr$ of the electrode film thickness and the line metalization ratio satisfies

$$\begin{aligned} & -8.04489 \times 10^{-5} \times \theta^3 - 1.40981 \times 10^{-2} \times \theta^2 - 0.825038 \times \theta - 16.0737 < H/\lambda \times mr < -6 \\ 5 \quad & .15517 \times 10^{-5} \times \theta^3 - 1.03943 \times 10^{-2} \times \theta^2 - 0.586564 \times \theta - 11.0052. \end{aligned}$$

4. A surface acoustic wave device comprising a piezoelectric substrate and an IDT that is formed on said piezoelectric substrate and is made from Al or alloy including Al as a main
10 component, an excited wave being utilized as an SH wave, wherein
said piezoelectric substrate is a quartz flat plate where a cut angle θ of a rotation Y cut quartz substrate is set to satisfy a range of $-61.4^\circ < \theta < -51.1^\circ$ in a counterclockwise direction from a crystal Z-axis, and a propagation direction
15 of a SAW is set to $(90^\circ \pm 5^\circ)$ to a crystal X-axis, and

when a wavelength of the SAW to be excited is represented as λ , an electrode film thickness H/λ standardized by a wavelength of the IDT is set to satisfy $0.05 < H/\lambda < 0.10$.

20 5. The surface acoustic wave device according to claim 4, wherein a relationship between the cut angle θ and the electrode film thickness H/λ satisfies

$$\begin{aligned} & -1.44605 \times 10^{-4} \times \theta^3 - 2.50690 \times 10^{-2} \times \theta^2 - 1.45086 \times \theta - 27.9464 < H/\lambda < -9.875 \\ & 91 \times 10^{-5} \times \theta^3 - 1.70304 \times 10^{-2} \times \theta^2 - 0.981173 \times \theta - 18.7946. \end{aligned}$$

6. The surface acoustic wave device according to claim 4,
wherein

when an electrode finger width of electrode fingers
constituting said IDT/(electrode finger width + space between
5 electrode fingers) is defined as a line metalization ratio mr ,
a relationship between the cut angle θ and a product $H/\lambda \times mr$ of
the electrode film thickness and the line metalization ratio
satisfies

$$-8.67632 \times 10^{-5} \times \theta^3 - 1.50414 \times 10^{-2} \times \theta^2 - 0.870514 \times \theta - 16.7678 < H/\lambda \times mr < -5$$

10 $.92554 \times 10^{-5} \times \theta^3 - 1.02183 \times 10^{-2} \times \theta^2 - 0.588704 \times \theta - 11.2768$.

7. The surface acoustic wave device according to any one of
claims 1 to 6, wherein

said surface acoustic wave device is a one-port surface
15 acoustic wave resonator where at least one IDT is disposed on
said piezoelectric substrate.

8. The surface acoustic wave device according to any one of
claims 1 to 6, wherein

20 said surface acoustic wave device is a two-port surface
acoustic wave resonator where at least two IDTs are disposed
along a propagation direction of a surface acoustic wave on said
piezoelectric substrate.

25 9. The surface acoustic wave device according to any one of
claims 1 to 6, wherein

said surface acoustic wave device is a lateral coupling type multi-mode filter where a plurality of surface acoustic wave resonators are disposed in proximity to each other in parallel with a propagation direction of a surface acoustic wave
5 on said piezoelectric substrate.

10. The surface acoustic wave device according to any one of claims 1 to 6, wherein

said surface acoustic wave device is a vertical coupling
10 type multi-mode filter where two-port surface acoustic wave resonators comprising a plurality of IDTs are disposed along a propagation direction of a surface acoustic wave on said piezoelectric substrate.

15 11. The surface acoustic wave device according to any one of claims 1 to 6, wherein

said surface acoustic wave device is a ladder type surface acoustic wave filter where a plurality of surface acoustic wave resonators are connected on said piezoelectric substrate in a
20 ladder shape.

12. The surface acoustic wave device according to any one of claims 1 to 6, wherein

said surface acoustic wave device is a transversal SAW
25 filter where a plurality of IDTs propagating a surface acoustic wave bidirectionally are disposed on said piezoelectric

substrate at predetermined intervals.

13. The surface acoustic wave device according to any one of claims 1 to 6, wherein

5 said surface acoustic wave device is a transversal SAW filter where at least one IDT propagating a surface acoustic wave in one direction is disposed on said piezoelectric substrate.

10 14. The surface acoustic wave device according to any one of claims 1 to 6, wherein

 said surface acoustic wave device is a surface acoustic wave sensor.

15 15. The surface acoustic wave device according to any one of claims 1 to 14, wherein

 said surface acoustic wave device has grating reflectors on both sides of an IDT.

20 16. A module device or an oscillation circuit using the surface acoustic wave device according to any one of claims 1 to 15.